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SECOND YEAR'S EXPERIMENTS IN THE TREATMENT OF GRAPE-VINE MILDEW IN THE BOMBAY PRESIDENCY.

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PREFACE

The experiments at Násik and Mundwa here recorded have been carried out by Messrs. Gole and Mr. Kirtane respectively. I must thank these gentlemen for the great help that has thus been given in the solution of the mildew problem. My assistants and myself visited the plantations periodically, took notes, and advised as to further treatment.

Mr. G. B. Patwardhan, B.Sc., Assistant Economic Botanist, has done the greater part of this work. I am indebted also to the expert knowledge and skill of Mr. S. L. Ajrekar, B.A., Assistant Professor of Mycology. Mr. Little, Superintendent of the Government House Gardens, has again assisted with his advice.

WILLIAM BURNS.

Poona, May 1911.

SECOND YEAR'S EXPERIMENTS IN THE TREATMENT OF GRAPE-VINE MILDEW IN THE BOMBAY PRESIDENCY.

In Bulletin No. 36 of 1910—*First Experiments in the Treatment of Grape-vine Mildew in the Bombay Presidency*—an account was given of the preliminary attempts to deal with this serious pest. The methods employed were careful pruning, removal of old bark, and periodic spraying with Bordeaux mixture plus soap. Bordeaux mixture is a mixture of copper sulphate and lime in water. Details of its preparation were given in the bulletin previously mentioned. This treatment was carried out at three centres—Násik, Mundwa, and Ganeshkhind. The results of the first year's work were distinctly hopeful. In continuation of these lines of work a similar procedure was adopted in 1910-11 at the same three centres. The following are details of observations made and the results obtained during the period under report.

NA'SIK.

Introduction.—The number of vines under experiment was largely increased. Messrs. Gole, encouraged by the results of the last year's spraying, decided to extend their operations this year. They, therefore, sprayed three vineyards which we shall call A, B, and C. A contained about 1,800 plants, half of which were eleven and half seventeen years old. The 100 vines sprayed last year were eleven-year old plants from this block. B contained about 1,400 eight-year old vines, and C was a vineyard planted in December 1909. The pruning of vineyards A and B was done between the 6th and 15th April 1910. The sprayings given to A were—

(1) April 28—May 2 ... Normal Bordeaux plus soap.

(2) July 15—16 ... " " "

Pruning was again done between October 8th and 12th, 1910, and sprayings given on—

(3) October 9—11 ... Normal Bordeaux plus soap.

(4) November 13—17 ... ·75 " " "

(5) December 9—19 ... ·50 " " "

B plantation was pruned at same time as A but did not receive the April and July sprayings. The sprayings given to B were—

(1) October 14—16	...	Normal Bordeaux plus soap.
(2) November 19—24	...	·75 " " "
(3) Dec. 23—Jan. 2, 1911	...	·50 " " "
(4) January 25—27	...	·30 " " " (only bunches sprayed).

C will be referred to later.

Pruning.—Pruning of all vines in A was done in April by the use of the secateurs, and in October by the *narkat*, followed by the secateurs. Finer work and more useful spurs are got by the secateurs than by the *narkat*. Two buds per spur were left in April and three to five in October, according to the local practice. In B the *narkat* alone was used. The effect of clean pruning is considerable. It is one of these measures of plant hygiene which are so essential to the welfare of fruit trees and yet so often neglected either through ignorance, indifference, or false economy.

Observations.—The following is a detailed account of the Násik treatment and of the observations made at each visit. The first visit was on 26th—29th April 1910. The seventeen-year old vines of A plantation had been pruned early (April 6) and the young growth was about four inches long. The eleven-year old vines in A had been pruned about April 15, and the buds were just commencing to sprout. Spraying was begun on the latter part of the plantation on April 28th with normal Bordeaux plus soap and the spraying of the older section completed on May 2. No mildew was seen.

The second visit was on July 20th. The vines had been sprayed for the second time on 15th—16th July. The spraying was not done earlier on account of heavy continuous rain which had made the fields very muddy and unworkable, and would moreover have removed at once any fresh spraying. An unsprayed vineyard (B) was first inspected. Here all the vines were affected with mildew. Ripe canes, tender shoots, old and young leaves all had the pest. Young tender leaves had curled up. In some cases further growth of shoots was arrested. The treated vineyard (A) was next carefully examined. Here also mildew had commenced to show. Young leaves had it mostly on the underside and had crumpled. The tender shoots had the characteristic patches in the last six internodes, but the attack was not visible on ripe canes and older leaves that had received the spraying of 28th April The affected parts were therefore those leaves and shoots that had grown after that spraying. Out of 17 bunches of grapes on

6 sprayed plants 2 were badly mildewed, and one had the mildew upon its stalk only, the other bunches were all right, and were composed of large sour berries. The rains crop in Násik never becomes sweet.

Four or five days before the third visit, namely on 12th September 1910, Mr. H. V. Gole, wrote us as follows :—

"There is a marked difference between the vines that were sprayed twice and the vines that were not sprayed at all. My brother proposes to treat both of his vineyards with Bordeaux mixture. I have suggested that the first spraying should be applied when the young shoots are some 4" long, and the second spraying 4 or 5 weeks later."

The third visit was on 16th—17th September 1910. The untreated vineyard (B) was first visited. All leaves had not dropped but were black spotted all over and many had become brown and parched looking. The tender shoots and young growth seen on the last visit had died and dropped and further growth arrested. We next inspected the treated vineyard (A). No further spraying had been done since last visit. All young growth referred to in last visit had dropped. The leaves on the older parts of the branches had not dropped. These leaves retained more vigour and were more sound than leaves of corresponding age in the untreated vineyard. They, however, showed dark marks indicating that mildew had spread to them from the younger shoots and leaves after the last spraying on July 16, 1910. The buds in both vineyards were plump and ready to burst.

The following point clearly comes out from the preceding observations :—

Between the spraying in July and our visit in September another spraying would have been highly beneficial both in preventing the spread of the mildew on older leaves and shoots and preventing its attack on the young growth.

On 14th November, Mr. H. V. Gole wrote as follows :—

"The vines in our garden were pruned on the 8th and 11th October ast. They were then sprayed with Bordeaux mixture of normal strength. I am now giving them a second spraying with a mixture reduced to ·75 strength of the normal. The new growth is showing a very healthy appearance. I have carefully searched for the presence of mildew but could not detect the least trace. The vines in my new vineyard (C) were not sprayed and here the presence of mildew can be easily seen. I shall give them one spraying to see what the effect will be."

The effect of this single spraying of the C plantation was described as follows in a letter of May 27, 1911, from Mr. H. V. Gole :—

"The effect of this spraying was to check the spread of the mildew and the vines presented a healthy appearance afterwards. As the plantation is quite young the growth was not very crowded and the spraying helped the vines to recover from the effects of the slight attack of mildew."

Some black-spotted branches were sent from Násik to Mr. S. L. Ajrekar, Assistant Professor of Mycology, who reported on them as follows on December 19, 1910 :—

"The berries and peduncle have black spots which resemble closely the spots known to be caused by the fungus *Phoma* or *Glœosporium* as it has been named by others. No fructifications were, however, found in any of the shoots. Destruction of diseased bunches and shoots as soon as observed would prevent the spread of this disease which is likely to become serious if neglected."

This note refers to a suspected case of that disease commonly known in Europe as Anthracnose. It is entirely different from mildew in appearance but very deadly to grape-vines. Anthracnose appears as sunken black spots on stems, leaves, and berries. Burning diseased portions as recommended above is necessary and the Bordeaux applied for mildew also helps to check this second pest.

Mr. Ajrekar himself made a visit to Násik on 3rd and 4th December 1910 and carefully inspected several vineyards. His report is as follows :—

"Visited Ráo Sáheb Gole's grape plantation in the afternoon. All his vines have been sprayed. Practically no mildew was observed in his vines. Anthracnose spots were observed here and there, but rare. The spray had wetted both surfaces of the leaf in most cases. The contrast between the sprayed and unsprayed plants could be observed in two or three vines which had been accidently left unsprayed in one part of the plantation. Mildew was present on these vines as in a neighbouring plantation which had not been sprayed. No *Plasmopara* (downy mildew) was observed in any plantation.

"Powdery mildew (*Oidium*) was abundant on several weeds and these were collected.

"Vines are reported to have suffered very greatly from powdery mildew at Sinnar 20 miles from Násik last year, in some cases there being complete loss of crop.

"Visited several vine plantations on the Bombay-Agra Road. None of these have been sprayed. Mildew was present more or less in every plantation except one.

"*Plasmopara* (downy mildew) was found on three or four leaves in one plantation. *Oidium* was also present in this and to greater extent."

It will be noted from the above report that there are two kinds of mildew—" downy " and " powdery ". The latter is the common one. It looks like flour sprinkled over both sides of the leaf. The other—the " downy " mildew—occurs mainly on the lower surface of the leaf and appears in small patches like very fine hairs with dust sticking to them. (See Plates I and II.)

Our fourth visit was on 19th—20th December 1910. The growth of new shoots was 4′—5′ long and new leaves were still appearing. For the third spraying given on 9th—19th December 1910 the amount of Bordeaux mixture used was considerably in excess of that previously required. This was of course on account of the greater spread of leaves and branches to be treated. No mildew was anywhere noticeable in the vineyard. Untreated vineyards in the neighbourhood were reported to be affected. Mr. Ajrekar previously reported the same thing.

Mr. H. V. Gole, on 3rd January 1911, wrote thus :—

" Our experiment on mildew is going to be a grand success. I am almost confident of it. We have only to wait for a month or so when the result will be pronounced with confidence. Beyond a sporadic appearance of mildew on some berries on one bunch here and there, all the vines present a healthy appearance. I shall give a detailed account with statistical information early in March next."

The next visit was paid on 14th January 1911. The first vineyard examined was the B plantation. To get an idea of the number of bunches attacked five plants in line and five plants at random were observed and the percentage of mildewed to non-mildewed bunches counted. The result was in this plantation—

Plants in line ...	Mildewed bunches ...	23·1 per cent.
	Non-mildewed " ...	76·9 "

This line was the third or fourth from edge and therefore not quite typical.

Plants at random...	Mildewed bunches ...	61·7 per cent.
	Non-mildewed " ...	38·3 "

The difference between these two sets of observations was due to these trees being farther from edge and subject to stiller air, more shade, and more moisture. In no case was the attack excessive. The attack had all developed, it was said, during the previous 10 days which had been warm and cloudy. This was obviously the case, since there were just the beginnings of attack on berries otherwise well grown. A similar examination of the

100 vines sprayed last year and also this year in A plantation gave the results :—

Plants in line ...	Mildewed bunches ...	89·5 per cent.
	Non-mildewed „ ...	10·5 „
Plants at random.	Mildewed bunches ...	84·9 „
	Non-mildewed „ ...	15·1 „

All attacks slight or moderate.

Similar examination of the remainder of this vineyard, sprayed—

Plants in line ...	Mildewed bunches ...	69·5 per cent.
	Non-mildewed „ ...	30·5 „
Plants at random.	Mildewed bunches ...	60 „
	Non-mildewed „ ...	40 „

Taking the average of all these figures collected regarding sprayed plantations we get—

Mildewed bunches.	Non-mildewed bunches.
23·1	76·9
61·7	38·3
89·5	10·5
84·9	15·1
69·5	30·5
60	40
6) 388·7	6) 211·3
64·8 per cent.	35·2 per cent.

Several neighbouring plantations belonging to other owners were observed. The contrast between them and the sprayed vineyards was enormous. In vineyards under canal irrigation there is a strong tendency to overwater, with the result that the soil and the atmosphere are full of moisture and conditions established which suit the spread of mildew. In such vineyards every bunch was attacked (100 per cent.). The attack was extremely heavy and the crop ruined.

These figures indicate to what extent the spraying has been effective in keeping the plants and fruits free from mildew. The number of bunches attacked on the plants observed has been reduced from 100 per cent. to 64·8 per cent. (a difference of 35·2 per cent.). This is remarkably close to last year's results when the reduction was from 77·4 to 40 per cent. (a difference of 37·4 per cent.). *The apparently high percentage of mildewed bunches in the above figures of sprayed vineyards does not mean that the spraying was unsuccessful. It means that a spraying early in January to check the attack on the forming berries is most essential.* This is the critical season and if the mildew gets ahead of the spraying there is little hope. Previous spraying has kept the tree clean so

far, but neighbouring vineyards are full of spores, hence infection of the forming berries goes on everywhere, and *this must be checked at its start by a spraying in the beginning of January.*

In a late pruned vineyard where the leaves had not yet spread and caused a close atmosphere, and where the berries were still small, the attack was much less. The proportions being:—

Plants in line ..	Mildewed bunches ...	55·4 per cent.
	Non-mildewed „ ...	44·6 „
Plants at random.	Mildewed bunches ...	35·4 „
	Non-mildewed „ ...	64·0 „

This vineyard was under well irrigation. It cannot be used for purposes of comparison with our sprayed plots, however, on account of the entirely different conditions produced by the late pruning.

The worst case of mildew was a vineyard of about 1½ acre of very heavy bearing trees for which at least Rs. 1,000 would have been received ordinarily but which was now absolutely worthless on account of mildew attack. How severe the attack was may be seen from the left hand bunch in plate 3. The other two bunches show on the contrary the state of sprayed berries. Perhaps one berry might be mildewed in such a bunch. Then in the statistics given the bunch is put down as " mildewed ".

Thus far results were satisfactory and there was every possibility of the usefulness of the spraying being conclusively demonstrated when the berries were fully ripened. But unfortunately early in February a frost occurred which wrecked the whole crop, sprayed and unsprayed, and rendered it impossible to make our final observations. Plate IV shows the effect of frost on the berries.

The following quotations from a letter of April 1911 from Mr. H. V. Gole gives his opinion on the matter:—

" The somewhat satisfactory results of your experiments with Bordeaux mixture last year induced me and my brother to undertake these experiments on a large scale. I am glad to say that our attempt was very successful. The season of 1910 was abnormal, the rainfall exceeding the average by some three inches of rain. As was to be expected the humid condition of the weather was more favourable to the growth and spread of the mildew. All vineyards round about Násik were attacked by mildew, and ultimately the crop was greatly damaged by it. Some vineyards withstood the attack for some time but by the beginning of January they too had to succumb. I was sorry to see the loss sustained by the poor cultivators. But I have mentioned this fact to prominently bring out the value of the remedial agent—Bordeaux mixture. My vineyards, measuring some five acres, were sprayed with the mixture, with the result that the vines withstood the attack of mildew and the crop was saved till the beginning of February when it was destroyed by frost."

" * * * * *

" What was the effect of the several sprayings on the two plots? The facts observed by me were these. The plot A was sprayed five times. The effect of the first two sprayings was to protect the sprayed parts but new growth was attacked by mildew to a great extent in August and September. The plot B which did not receive these sprayings suffered similarly but here new growth was mildewed as well as the old. After the second or October pruning both plots were treated similarly. The fourth and fifth sprayings on plot A and the first and second on plot B failed to check the appearance of mildew, though its presence was sporadic, showing that the mixture acted as a good preventive. The effect of the fifth spraying on A and the third on B was to check the spread of such mildew as had appeared before this spraying. In the fourth spraying on B the bunches only were treated. The effect of this spraying cannot be judged as the crop was destroyed by severe frost in February.

" What happened in other vineyards? All were attacked by mildew and the crop was practically destroyed. But the time of the attacks varied considerably. Some vineyards were attacked as early as the 25th of November while others were quite free till the 15th of December, and a few withstood the attack as late as the 8th January. Though mildew did make its appearance in the two plots sprayed with the mixture it was unable to do any serious harm to the crop, except to a few berries here and there.

" From these facts it would seem that the Bordeaux mixture acts as a good preventive against mildew and in an early stage of affection it acts as a cure to some extent.

" * * * * * "

The following table prepared by Mr. Gole shows in statistical form the details of the sprayings given after the October pruning :—

Vineyard	Approximate number of vines.	Spraying number.	Copper sulphate used in lbs.	Lime used in lbs.	Soft soap used in lbs.	Water used in gallons.	Number of days required.	Strength of Bordeaux.
A	1,800	3rd.	24	*Sufficiency.	20	200	4	Normal.
		4th.	27		21	300	6	·75 "
		5th.	45·5		34	750	13	·50 "
B	1,400	1st.	20	*Sufficiency.	16	160	3	Normal.
		2nd.	31·5		21	350	6	·75 "
		3rd.	40·5		31	650	11	·50 "
		4th.	12·5		11	350	5	·30 "

NOTE.—*In ordinary cases unslaked lime is taken at the rate of 4 lbs. to 6 of copper sulphate but the amount of stones and other débris in lime varies, hence the amount of lime is regulated accordingly, applying the steel knife test to the Bordeaux solution when prepared.

MUNDWA.

Last year we sprayed 100 vines. The plan of experiment this year was to omit spraying some of the vines sprayed last year and to spray some extra vines. This was done and we therefore had—

3 lines of vines sprayed in		1909-10 only.
3	,,	1909-10 and 1910-11 both.
2	,,	1910-11 only.

The following is a summary of the treatment given :—

Pruning done	...	March 20th.			
Sprayings	...	April 7, 1910,	Bordeaux	normal	plus soap.
		June 14	,,	,,	,,
Pruning	...	October 6	,,	,,	,,
Spraying	...	November 10	,,	,,	,,
		January 27	,,	½ normal	plus soap.

Our first visit was on 1st April 1910. The vineyard had been pruned 10 days before and the young shoots were up to 4″ long. Four or five leaves were appearing on the larger branches. On some shoots inflorescences even were visible. No mildew was seen. There were no large ugly spurs but the pruning done was still such as to give a lot of useless wood and considerable crowding of branches. After spraying it is obvious that the next thing to do is to teach the mális how to produce a neat compact spur. The treatment of land so far was one ploughing in 3 directions after pruning. The land was thrown into chains of beds. Each plant was then manured with 1 lb. of mowra cake obtained from the adjacent distillery, and immediately irrigated. Up to March 5th in the whole vineyard no mildew noticed. Mr. Ajrekar on 6th June reported powdery mildew on the peduncles of bunches.

The second visit was made on 16th June. A superficial examination of sprayed and unsprayed vines indicated a slight attack of mildew on the stalks of bunches in the unsprayed vines. A careful examination of all the *bunches* in these lines gave the following result :—

	Mildewed.
Sprayed 1909-10	0 per cent.
,, 1909-10, 1910-11	1·9 ,,
,, 1910-11	2·3 ,,
Not sprayed adjacent line	17·9 ,,
,, one line far in the middle of unsprayed lines ...	54·3 ,,

Some *shoots* (as well as bunches) in unsprayed portion of the vineyard had patches of mildew.

The third visit was on 28th July. The weather since the previous visit had been cloudy and close with little rain. No further spraying had been done. Water was given on the date of our visit. A general survey showed that the sprayed vines as a block were less attacked than the unsprayed as judged by the appearance of the foliage. Very few of the sprayed leaves had mildew on the blade but mildew was common on the stalk of sprayed leaves. The young shoots, being growth since last spraying, had mildew on internodes, nodes, stalks and back of the leaves. The older leaves of the unsprayed vines had mildew on the back and stalk and showed black areas. The young leaves, nodes and internodes were badly attacked, and the stems had become absolutely covered with white stuff and black patches. The trees on the south-west end of the sprayed block showed less young growth and also less mildew on the old growth than the north-east end of the sprayed block. No distinct difference was observed between the three portions of the sprayed block.

The next visit was on 13th September. Since the last visit no irrigation had been given on account of rainy weather. The soil had been sodden and had hardened due to the fair weather prevailing in the course of the week. A general survey of the *unsprayed* portion showed that the vines had completely shed their leaves and their pendent dark branches gave a burnt appearance to the vineyard. Buds on the branches had swollen. In some places new growth had already appeared. The old leaves that still remained were very feebly attached to the plant. The sprayed vines presented a remarkable contrast to the above as the following observations show. The block had not lost all its leaves. Those on about two-third of the length of the canes still persisted, while the rest toward the tip had dropped. The old growth continued in a resting state and a few new growths had started. The persisting leaves did not drop at a touch as in the case of the unsprayed portion. The swelling of the buds was not so noticeable. The above description applies in full to the vines sprayed both in 1909-10 and 1910-11. The vines, sprayed last year only, were very like the entirely unsprayed vines in the matter of the shedding of the leaves. Results may be summarised thus :—(1) the two years' spraying gave extra vigour to the vine, (2) the buds in the sprayed portion were still dormant, (3) the abandoning of the spraying for one season had to a certain extent brought the plants back to the

condition of the unsprayed vines, (4) the vigour of the two years sprayed block was the greatest of the four sections.

Our next visit was on November 9th. The vines were pruned between 29th September and 6th October. The growth was up to 4½ feet long, vigorous and bright. In the earlier pruned ones, *i.e.*, unsprayed part, flowers had opened and had been fertilised. In several instances the inflorescence had darkened and died but no fungus was noticed. In the later pruned part (sprayed) the flowers had not yet opened. This portion looked as good as the rest, and no difference as to vigour, colour, etc., could be noticed between them and the unsprayed part. Very careful search disclosed no trace of mildew anywhere in the vines. Immediate spraying was recommended.

Mr. Ajrekar on 10th November noted no powdery mildew (*Oidium*). Downy mildew (*Plasmopara*) was found abundantly on the Sahebi variety and to a much less extent in the Bhokri variety. None was noticed on the few plants of the Kali variety. On November 19, Mr. Ajrekar noted that the *Plasmopara* seemed to be spreading on the Bhokri variety but only in the unsprayed portion. The sprayed portions did not seem to have either mildew till then. On November 22, Mr. Ajrekar reported presence of Anthracnose on a few branches. On November 19, there was no *Oidium* to be found on the leaves affected by the downy mildew, which seemed to be progressing on the Bhokri variety also, though only in the unsprayed portion of the plantation as far as could be seen. No *Oidium* could be seen in any part of the plantation.

On December 15, in the unsprayed portion of the vineyard *Oidium* was apparent on at least one berry in each bunch examined, usually a small ill-formed berry. There appeared to be no *Plasmopara* and I saw no Anthracnose in this visit. Mr. Kirtane had cut off the long protruding ends of many of the branches on each vine at least in the twice sprayed section with object of forcing sap into the bunches. We found in all the bunches of one line in the twice sprayed section only one mildewed berry.

On January 18, 1911, examination was made in the usual way of 5 trees in line and 5 at random in all the sections. Results are as follows :—

Sprayed 1909-10, not sprayed 1910-11—

In line ...	Mildewed bunches...	100 per cent.	Same as if not sprayed at all.
	Non-mildewed " ...	0 "	
At random ...	Mildewed " ...	100 "	
	Non-mildewed " ...	0 "	

Sprayed 1909-10, 1910-11—

In line ...	Mildewed bunches ...	83	per cent.
	Non-mildewed " ...	17	"
At random ...	Mildewed " ...	84·5	"
	Non-mildewed " ...	15·5	"

Some berries on thinned bunches were now attacked. These were not so at time of last visit.

Sprayed 1910-11 only—

In line ...	Mildewed bunches ...	85	per cent.
	Non-mildewed " ...	15	"
At random ...	Mildewed " ...	97	"
	Non-mildewed " ...	3	"

Unsprayed—

Line 4th from east.	Mildewed bunches...	100	"
	Non-mildewed " ...	0	"

Some mildew on leaves also—

Random ...	Mildewed bunches ...	100	"
	Non-mildewed " ...	0	"

Taking the average of the plantations sprayed this year we get :—

Mildewed bunches.	Non-mildewed bunches.
83 per cent.	17 per cent.
84·5 "	15·5 "
85 "	15 "
97 "	3 "
4) 349·5	4) 50·5
87·4	12·6

As at Násik the attack on many of the bunches labelled "Mildewed" was very slight. The difference between these figures and the Násik figures is almost certainly to be accounted for by the fact that no spraying had been given at Mundwa between November 10 and the date of this visit, that is, during the critical period of December and early January the forming berries were unprotected and hence the mildew got a hold. Even then, however, the sprayed trees were much better than the unsprayed which both at Mundwa and Násik gave 100 per cent. mildewed bunches.

A spraying with ½ normal was given shortly after this visit to check the mildew on bunches.

The Jungli or Kali variety was not attacked. The leaves of Sahebi were nearly all gone with mildew. The berries were

moderately attacked. The attack on the whole in the Mundwa garden was much less than at Násik. Sprayed portions II and III were much better than the unsprayed. The attack was mainly on the stalks of bunches. (*Cf.* Násik where it was mainly on the berry.)

On visiting the garden on February 19th, it was seen that frost damage of February 1st and 2nd was severe especially on the east part of the garden. The fruits were shrivelled.

Nearly all branches and leaves were brown and dead. The tops were worst and the top berries of bunches were worst. Mildew was still present. It did not seem to persist saprophytically on dry berries when the experiment was carried out in the laboratory. The Jungli or Kali tree was unattacked by mildew and almost unscathed by frost; only a few scattered berries were shrivelled and some brown spots appeared on the leaves. The berries were colouring and nearly ripe. Plate IV shows the *Kali* variety (central bunch) and its condition compared with Bhokri bunches from neighbouring vines.

Frost damage was follows :—

	Bunches unspoiled. Per cent.	Partly spoiled. Per cent.	Completely spoiled. Per cent.
Five trees of each examined—			
Sprayed 1909-10 ...	38·8	38·8	22·4
„ 1909-10, 1910-11 .	16	21·4	62·6
„ 1910-11 ...	5·1	24·1	70·8
Unsprayed ...	0	21·9	88·1

The frost attack decreased towards the west side. The decrease was probably not due to the spraying. The attack was much less severe than that on some gardens at Ahmednagar.

On March 1911 Mr. Ajrekar reported mildew on some weeds and also downy mildew on grape leaves. Frost bitten grapes were collected to see if mildew was capable of saprophytic growth on them. Some bunches were put in dry and some in damp chambers with a few mildewed berries along with each. There was no evidence of the mildew spreading on to the shrivelled berries. A large number of bunches affected by the frost were examined.

The meaning of these various observations will be considered later when we discuss the results generally.

NOTE.—The vines called Bhokri above are known in Mundwa as Phukdi, but their characters are those of the Násik Bhokri vines.

GANESHKHIND GARDEN.

The vines on trellis were treated as follows :—Pruning was done on 29th March 1910; the vines were taken down and coiled and then sprayed with normal Bordeaux plus soap.

They were also sprayed on—

(2) June 20, 1910	...	Normal Bordeaux plus soap.
(3) August 28, 1910	...	" " "
(4) September 16, 1910	...	" " "

Pruning was again done on October 21, 1910, and sprayings on—

(5) October 21, 1910	...		Normal Bordeaux plus soap.
(6) November 17, 1910	...		" " "
(7) January 7, 1911	...	·50	" " "
(8) February 1, 1911	...	·33	" " "

The following observations were made. Mildew was first observed on August 16. Previous to that rain had washed of the June spraying. The appearance of this trace of mildew in August was the signal to re-spray. The land was dug and cleaned in September and the roots exposed on October 12 and covered on November 1. The growth after the October pruning was vigorous and on November 22 had reached 2 feet long showing inflorescences. Only one plant showed mildew, and it had been pruned earlier than the others, namely, on September 28. A heavy spraying was given this plant. The mildew was for the time arrested but the excessive spraying scorched many of the young leaves. Mildew re-appeared in January and spread so rapidly on the bunches that it got ahead of the spraying and rendered the bunches unfit to eat. Anthracnose appeared also.

The number of vines here being small, statistical observation comparable with those made at Násik and Mundwa are not as ye possible.

KARA'CHI.

I was informed, while in Karáchi, that mildew is unknow there.

GENERAL DISCUSSION OF RESULTS.

1. *Beneficial effect.*—These two years' work show that th spraying is instrumental in checking the spread of the mildew The degree of success depends entirely on the thoroughnes and timeliness of the spraying. Let us consider these two point separately—

(*a*) *Thoroughness.*—It is necessary to wet both sides of leaves and hence the vines must be sprayed from below as well as from above. It is necessary also to see that recesses of the foliage are reached by the spray.

(*b*) *Timeliness.*—From these two years' work it is clear that as regards Násik, Mundwa and Ganeshkhind Botanical Garden the most critical season is the middle of December to the middle of February when the fruits are forming and swelling. The bunches must be sprayed with $\frac{1}{2}$ normal Bordeaux and soap whenever all the flowers have disappeared and the berries formed, and close watch must afterwards be kept over the bunches. The appearance of a trace of mildew upon one berry in a bunch must be the signal to respray that bunch. Next in importance to this period it is important to spray in the breaks of the early rains.

2. *Kinds of Mildew.*—Two distinct kinds of mildew were noticed—the downy and the powdery. The downy appears first and attacks mainly the leaves, the powdery appears later and attacks all parts of the plant, being worst on the grape bunches and stalks. For both the Bordeaux application is useful.

3. *Anthracnose.*—This disease, while found here and there, is not yet serious but may easily become so if not checked. The affected branches should be cut off and burned.

4. *Future work.*—It is proposed to continue these experiments with increasing accuracy and various modifications suggested by experience at the three centres named above.

5. *Resistant variety.*—The variety Jungli or Kali in Mr. Kirtane's garden appears to have a real quality of mildew and frost resistance. The fruit, however, is not so good as the less resistant varieties, the pulp being very gelatinous. Experiments will be made to see if the resisting character of this variety can be imparted by grafting or crossing to sweet fruited varieties, and research will also be made to determine if possible the nature and causes of this resistant power.

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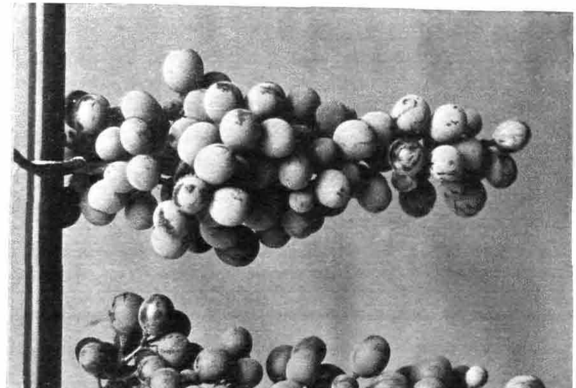
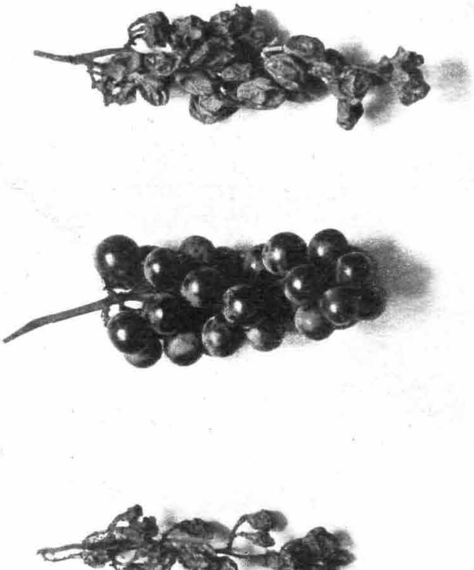
PLATE I.

Powdery mildew (Oidium) of the Grape Vine.

Plate II.

Downy Mildew (*Plasmopara*) of the Grape Vine.